teristic data is collected, the design values in the fabrication vector **126** are replaced by the measurement data.

Various technology computer-aided design (TCAD) tools are commercially available for performing the functions of the modeling engine **122**. The particular modeling tool selected depends on the type of semiconductor device being fabricated and the type of electrical characteristics for which predictions are desired. Exemplary software tools are Tsuprem-4 and Medici offered by Synopsis, Inc. of Mountain View, Calif. Exemplary electrical characteristics that may be predicted by the prediction unit **130** are drive current, ring oscillator frequency, memory cell erase times, contact resistance, effective channel length, etc.

There are various uses for the predicted electrical characteristics. For example, the prediction unit **130** may provide its predictions to the fault monitor **115** for fault detection purposes. If the predicted electrical characteristics are outside a predetermined range, a problem with the wafers **200** or the process tools **30** used to fabricate the wafers **200** may be present. The fault monitor **115** may initiate an automatic corrective action based on the predicted electrical characteristics. Exemplary corrective actions include sending an alert message to fabrication personnel to suggest troubleshooting the problem, automatically halting subsequent processing, marking the wafers as suspect, etc.

Another use for the predicted electrical characteristics is process control. The prediction unit **130** may pass the predicted electrical characteristics to one or more process controllers **100** for updating the operating recipes of their controlled tools **30**. For example, if the predicted contact resistance of a device is too high, the process controller **100** may adjust a metal plating parameter to reduce the contact resistance for subsequent wafers **200**. The process controller **100** may also adjust parameters such as implant dose and energy to affect the electrical performance of subsequent transistor devices.

The predicted electrical characteristics may also be used for scheduling purposes. For example, the MES server **70** may adjust the priority of the lot including the wafer **200** if the predicted electrical characteristics indicate a high-performing device or a device having predicted electrical characteristics consistent with a business need for devices of a certain grade. Also, the MES server **70** may make scheduling decisions based on the predicted electrical characteristics. For example, the MES server **70** may schedule lots with higher predicted electrical characteristics to be processed by tools **30** with higher tool health (e.g., clean tool, low defect rate, low overlay error, etc.).

The predicted electrical characteristics may be used to generate feedback for updating the prediction model employed by the modeling engine **122**. When the actual characteristics of the semiconductor device are measured, they can be compared with the predicted values to generate an error signal. This error signal may be used by the modeling engine **122** to adjust its model parameters to reduce the magnitude of the error for future predictions.

Turning now to FIG. **3**, a simplified flow diagram of a method for predicting device electrical parameters during fabrication in accordance with another illustrative embodiment of the present invention is provided. In block **300**, a set of initial characteristic values associated with the semiconductor device is provided. In block **310**, a first fabrication process on the semiconductor device is performed. In block **320**, fabrication data associated with the first fabrication process is collected. In block **330**, at least one of the initial characteristic values is replaced with the fabrication data collected for the first fabrication process to generate a first modified set of characteristic values. In block **340**, a first value for at least one electrical characteristic of the semiconductor device is predicted based on the modified set of characteristic values.

Predicting the electrical characteristics of the semiconductor device during the fabrication process has numerous advantages. Insight may be gained regarding the manufacturing processes as well as the future performance of the semiconductor device. Conventionally, this information is only available late in the fabrication process. Generating the predictions during the fabrication process allows process settings to be adjusted, fault conditions to be identified, and scheduling decisions to be made based on the anticipated performance of the devices being fabricated.

The particular embodiments disclosed above are illustrative only, as the invention may be modified and practiced in different but equivalent manners apparent to those skilled in the art having the benefit of the teachings herein. Furthermore, no limitations are intended to the details of construction or design herein shown, other than as described in the claims below. It is therefore evident that the particular embodiments disclosed above may be altered or modified and all such variations are considered within the scope and spirit of the invention. Accordingly, the protection sought herein is as set forth in the claims below.

What is claimed:

1. A method, comprising:

providing a set of initial characteristic values associated with a semiconductor device;

performing a first fabrication process on the semiconductor device;

collecting fabrication data associated with the first fabrication process;

replacing at least one of the initial characteristic values with the fabrication data collected for the first fabrication process to generate a first modified set of characteristic values; and

predicting a first value for at least one electrical characteristic of the semiconductor device based on the first modified set of characteristic values.

2. The method of claim **1**, further comprising:

performing a second fabrication process on the semiconductor device;

collecting fabrication data associated with the second fabrication process;

replacing at least one of the initial characteristic values with the fabrication data collected for the second fabrication process to generate a second modified set of characteristic values; and

predicting a second value for the at least one electrical characteristic of the semiconductor device based on the second modified set of characteristic values.

3. The method of claim **1**, further comprising identifying a fault condition associated with the semiconductor device based on the first value of the electrical characteristic.

4. The method of claim **1**, further comprising scheduling the semiconductor device for subsequent processing based on the first value of the electrical characteristic.

5. The method of claim **1**, further comprising determining at least one operating recipe parameter for processing a subsequent semiconductor device based on the first value of the electrical characteristic.

6. The method of claim **1**, wherein predicting the first value for the electrical characteristic of the semiconductor device further comprises predicting at least one of a drive current, a ring oscillator frequency, a memory cell erase time, a contact resistance, and an effective channel length.